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SMALL-MAMMAL RESPONSES TO FIRE IN THE MONTE DESERT, ARGENTINA

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The role of habitat complexity in structuring desert small-mammal assemblages has been studied extensively in major North American arid habitats (Brown and Lieberman, 1973; Price, 1978; Price and Brown, 1983; Rosenzweig, 1973; Rosenzweig and Winakur, 1969). Moreover, studies on convergence between Sonora (USA) and Monte (Argentina) desert mammals have provided insights into community organization, and the ecomorphological and physiological adaptations or constraints to xeric existence in both deserts (Mares, 1975, 1976, 1980). However, at a microgeographic level, almost nothing is known about habitat selection of small mammals of the Monte Desert. Responses of these species to changes in vegetative structure are unknown and their impact on the diversity and composition of the larger community remains unclear.

The present study results from long-term research on vertebrates of the central Monte Desert, and deals with the dynamics of an assemblage of small mammals in response to fire perturbation in a creosote bush (*Larrea*)-grass habitat.

Unlike the semiarid thornscrub or Chaco Biome, where fires are (or were) a regular occurrence and are hypothesized to play a significant role in affecting community composition (Morello, 1970), fire is an uncommon phenomenon in the Monte. Nonetheless, fires occur occasionally and provide opportunities for natural-perturbation experiments that facilitate assessment of the effect of vegetative structure on small-mammal assemblages.

Based on reported patterns of microhabitat use by desert small mammals, predictions about the response to vegetational changes associated with fire would include a decrease in species richness associated with reductions in vegetational complexity, and rapid increases in abundance by those species whose primary microhabitat is augmented by fire. In this particular case, removal of vegetation by fire created a large patch of open habitat. This should be accompanied by an increase in abundance of species having ecomorphological traits that enable exploitation of open habitats and a decrease in abundance by those species less specialized to cope with open habitats. The first prediction is based upon the known correlation of rodent species diversity with habitat complexity (Rosenzweig and Winakur, 1969; Rosenzweig et al., 1975), whereas the latter is based on analysis of ecomorphological convergence among desert rodents by Mares (1975, 1976, 1980).

The study area, located in the Man and the Biosphere Reservation of Ñacuñan (34°02′S, 67°58′W), Mendoza Province, Argentina, is contained within the Monte Desert Biome (Morello, 1958). The climate is strongly seasonal, with hot humid summers and cold dry winters. Average annual precipitation is 326 mm, mostly concentrated during summer (December–February), with a slight peak in spring (September, $\bar{X} = 30$ mm).
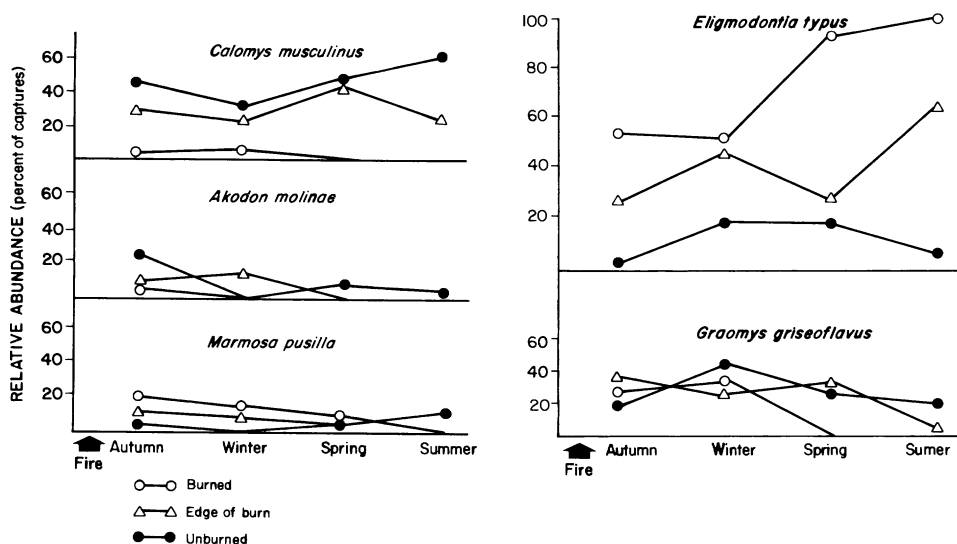
FIG. 1.—Small-mammal responses (changes in relative abundance) on unburned (A), edge of burn (B), and burned (C) sites, during the year following the fire perturbation.

Approximately 60 ha of a *Larrea*-dominated grassland was burned within the Reserve in January 1986. Dominant vegetation before the fire included *Larrea cuneifolia*, *L. divaricata*, *Atriplex lampa*, *Lycium* sp., scattered individuals of *Prosopis flexuosa* and *Geoffroea decorticans*, and a mixture of grasses and forbs (e.g., *Pappophorum*, *Chloris*, *Sporobolus*, *Digitaria*). Two parallel transects, 15 m apart and 150 m long, were established in each of three different areas within the *Larrea*-grassland (unburned, site A; partially burned, site B; and completely burned, site C). Trap stations were 15 m apart and totaled 10 per line. Two Sherman live traps (25 by 8 by 7.5 cm) were set at each station and were baited with oatmeal and peanuts. Traps were operated for 3–4 consecutive nights each month from January 1986 until February 1987 (except in July, August, September 1986, and January 1987). Species, sex, age, and body mass of captured animals were recorded before they were released.

Species composition, number of vertical strata, and percent coverage of vegetation was determined at each trap station at the beginning (autumn) and middle (spring) of the census period. The unexpected occurrence of the fire (lightning?) prevented a preperturbation treatment. Nonetheless, occasional trapping was conducted before the fire in 1983, 1984, and 1985, and supported the assumption that preburn conditions on site C were similar to those of the unburned site A.

A total of 515 captures was recorded during 2,920 trap nights. Five species of small mammals (<100 g), four rodents and one marsupial, were trapped in the following proportions: *Eligmodontia typus* (39%), *Calomys musculinus* (28%), *Graomys griseoflavus* (21%), *Akodon molinae* (5%), and *Marmosa pusilla* (7%).

Comparisons of live-trapping data from unburned and burned sites show that decreases in species richness and relative abundance (captures/100 trap nights) followed the burn (Table 1). Species richness fluctuated from three to five species at sites A and B. A gradual decline from five to one species was observed at site C after the burn; *E. typus* was the only species present at the end of the following summer. These changes were correlated with a general decrease in vegetational complexity. Average percent of plant cover (shrubs, grasses, and forbs combined) for sites A, B, and C was 89%, 49%, and 14%, respectively, during autumn. This is a 6.4-fold decrease between sites A and C. The burned area exhibited a 2.5-fold increase in plant coverage during the spring census, mainly because of annuals.

The highest frequency of captures (expressed as percent of captures; Fig. 1) for most of the year was on the unburned site A. Capture frequency was higher at the edge of the burn during winter. A marked difference in relative abundance (between 58% and 73% of the frequency of captures) was observed between the unburned and burned sites. Mean capture frequencies for sites A, B, and C were 23.2, 18.0, and 14.3, respectively.

Composition of the small-mammal assemblages, based on total captures for each species (all seasons pooled), was significantly different among sites (chi-square contingency test, $\chi^2 = 185.7$, *d.f.* $= 8$, $P < 0.001$). The

TABLE 1.—Species composition and relative abundance (captures/100 trapnights) of small mammals along unburned (A), edge of burn (B), and burned (C) sites, Mendoza Province, Argentina, 1986–1987.

| Species and category	Body mass (g)	Autumn			Winter			Spring			Summer		
		A	B	C	A	B	C	A	B	C	A	B	C
Eligmodontia typus	19	1.0	6.2	10.8	4.2	13.3	7.5	3.3	2.1	10.8	1.2	5.3	11.8
Graomys griseoflavus	60	8.0	6.0	4.7	10.8	6.6	4.2	4.6	3.0		3.4	0.6	
Calomys musculinus	16	16.0	7.8	0.3	8.3	7.5	0.8	9.2	4.6		11.0	2.5	
Akodon molinae	33	8.5	0.6	0.5		2.5		1.2			0.6		
Marmosa pusilla	22	1.0	2.2	3.8		2.5	1.6	0.4	0.4	0.4	0.9		
Species richness (n)		5	5	5	3	5	4	5	4	2	4	3	1
Individuals (n)		69	73	73	28	39	17	45	24	27	55	27	38
Trap nights (n)		200	320	360	120	120	120	240	240	240	320	320	320
Captures/catching effort		34.5	22.8	20.1	23.3	32.4	14.1	18.7	10.1	11.2	17.1	8.4	11.8
Mean percent of plant coverage (shrubs, grasses, and forbs combined)		89	49	14				84.7	42.7	35.2			
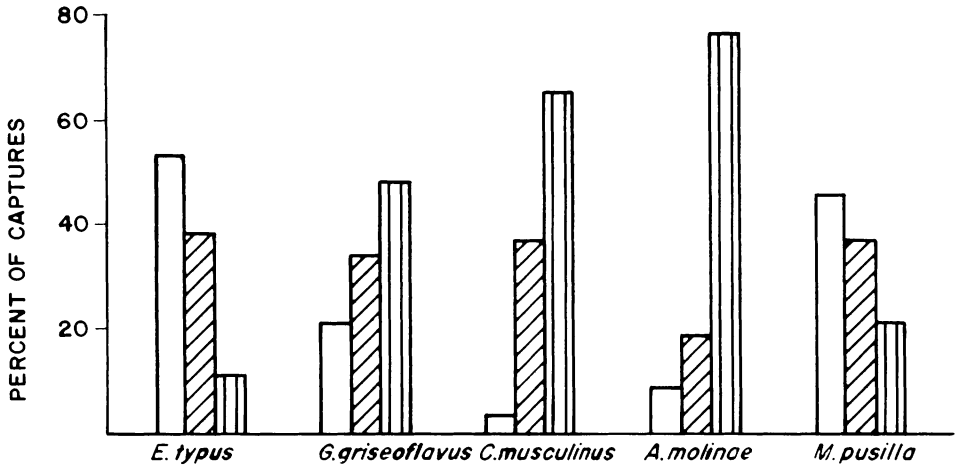
FIG. 2.—Habitat use by species of a small-mammal assemblage of the central Monte Desert, Argentina, 1986–1987. Vertical bars indicate unburned habitat (site A), diagonal bars edge of burn (site B), and open bars burned habitat (site C). Percent captures differed significantly among areas for all species except *M. pusilla*.

vesper mouse, *C. musculinus*, was dominant (higher frequency of captures) on sites A and B, whereas the burned site C was dominated by the gerbil mouse, *E. typus*. The relative abundance of the gerbil mouse increased along a habitat gradient from high to low vegetational coverage (A > B > C). Percentage of captures ($n = 189$) for *E. typus* was 10%, 37%, and 53%, for sites A, B, and C, respectively (Fig. 2). The gerbil mouse showed significant affinity (chi-square test based on number of captures) with the low-cover site C ($\chi^2 = 55.6$, $d.f. = 2$, $P < 0.001$). Frequency of captures fluctuated between 1.0 and 4.2 on the unburned site, whereas frequencies of 7.5 and 11.9 were recorded at the burned site. Intermediate values were obtained for the burn-edge site B.

The gray, leaf-eared mouse, *G. griseoflavus*, was the second most abundant species on the unburned site. Its relative abundance remained similar on the three sites during autumn and winter, until it completely disappeared from the burned site in spring. Its capture frequency increased as vegetational complexity increased. Percent distribution of total captures ($n = 109$) was 47%, 33%, and 20% for sites A, B, and C, respectively. *G. griseoflavus* showed significant habitat selection ($\chi^2 = 17.4$, $d.f. = 2$, $P < 0.001$) and occurred in higher than expected frequencies on the high-cover site A.

Numbers of the vesper mouse declined sharply on the burned site until the species was not present in spring. Its capture frequency increased as plant coverage increased. Percent distribution of captures ($n = 154$) on sites A, B, and C were 64.3%, 34.4%, and 1.3%, respectively. The vesper mouse showed significant selection ($\chi^2 = 110.5$, $d.f. = 2$, $P < 0.001$) for high-cover site A.

Molina's grass mouse, *A. molinae*, occurred at low abundances throughout the study. It was the first to disappear from the population on the burned site, and remained at low levels on site A. It was unrecorded from site B in spring and thereafter. Percent distribution of captures ($n = 29$) for sites A, B, and C was 75.8%, 17.2%, and 7%, respectively. Molina's grass mouse showed significant selection ($\chi^2 = 29.3$, $d.f. = 2$, $P < 0.001$) for the high-cover site A. The common mouse opossum, *M. pusilla*, exhibited a marked increase in relative abundance following the summer burn, then declined steadily until summer 1987 when it was absent. Percent distribution of total captures ($n = 34$) was 20%, 36%, and 44%, for sites A, B, and C, respectively. No significant habitat selection was found for *M. pusilla* ($\chi^2 = 1.9$, $d.f. = 2$, $P > 0.05$).

Significant differences (paired *t*-test) in relative abundances between burned and unburned sites (A and C), with data paired for each of the four seasons, were found for *E. typus* ($t = 4.737$, $d.f. = 3$, $0.02 > P > 0.01$), *G. griseoflavus* ($t = 5.831$, $d.f. = 3$, $0.02 > P > 0.01$), and *C. musculinus* ($t = 6.137$, $d.f. = 3$, $0.01 > P > 0.001$). No significant differences were detected for *A. molinae* and *M. pusilla*.

These preliminary observations on the effect of fire in the Monte Desert suggest differential responses to fire-associated changes in the *Larrea*-grass habitat. These responses support my predictions. Species also exhibited differential use of habitats. Affinities for particular vegetative structures might be a proximate cue that mediates the potential effects of competition or predation, or simply reflects different foraging behaviors

and dietary requirements (Price, 1986). The observed pattern of habitat selection is consistent with a gradient of ecomorphological adaptations for inhabiting the arid areas (Mares, 1975, 1976, 1980). The rapid response to fire and dominance of *E. typus* in habitats of low cover (burned site C) may be a consequence of its general morphological and physiological adaptations to xeric existence in open habitats. The dominance of annuals (e.g., *Lappula, Heliotropium, Plantago,* and *Parthenium*) on the burned site during spring (100% of the trap stations, and none on the "control" site A) also may account for the response of *E. typus* (increased ability to exploit the resource base in open habitats).

Whether the negative response of *C. musculinus* on the burned site is related to interference with *E. typus*, predation, or other factors requires further investigation. Analysis of diet composition shows a high similarity among *E. typus* and *C. musculinus* in consumption of grasses, seeds, and insects. We incidentally observed the hystricognath rodent, *Lagostomus maximus*, during secondary succession after the fire. Its ability to colonize open patches, and its herbivorous diet, prevented recovery of the grass stratum 1.5 years following the fire. Thus, site C remains devoid of grasses, with bare soils, and an unusual vertebrate assemblage that exploits these open, desert-like habitats.

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